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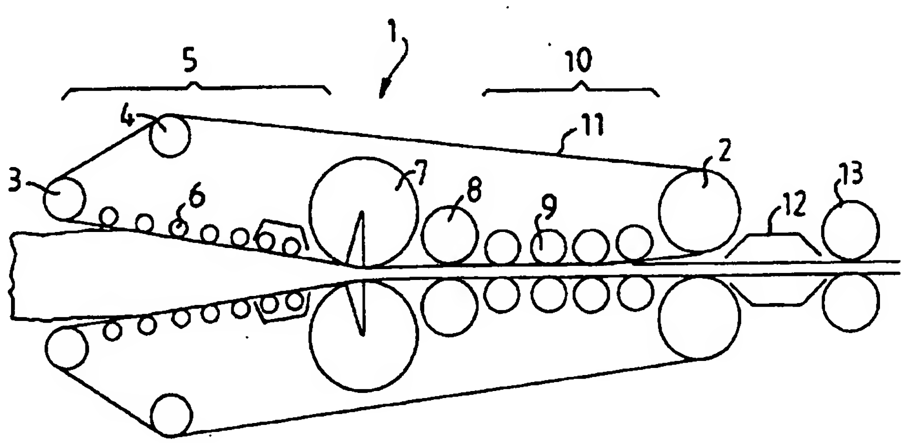
(54) Title: METHOD OF MANUFACTURING LIGNOCELLULOSIC BOARD



(57) Abstract

A method for the continuous manufacture of board from lignocellulosic material, where the material is disintegrated to particles and/or fibers, dried, glue-coated and formed to a mat and pressed to a finished board. The formed mat is heated with steam and thereafter compressed to near final thickness, whereafter it is pressed to a manageable board in a calibration section.

Method of manufacturing lignocellulosic board

This invention relates to a method for the continuous manufacture of board from lignocellulosic material.

Methods of manufacturing board from raw material based on lignocellulose are well-known and widely used in practice. The manufacture comprises the following steps: disintegration of the raw material to particles and/or fibers of a suitable size, drying to a definite moisture ratio and glue-coating the material prior to or after the dying, forming the glue-coated material to a mat, which can be built-up of several layers, possibly cold pre-pressing, pre-heating, nozzle-spraying of the faces etc,. as well as a hot pressing at the simultaneous application of pressure and heat in a discontinuous or continuous press to a finished board.

At conventional hot pressing the pressed material is heated substantially by thermal conduction from adjacent heating plates or steel belts, which have a temperature of 150-250°C, depending on the type of pressed product, used glue type, desired capacity etc. The moisture of the material closest to the heat sources is hereby vaporized, whereby there a dry layer develops, and a steam front moves successively inwardly to the board core from each side as the pressing proceeds. When the dry layer develops, a temperature of at least 100°C prevails in this layer, which initiates normal glues to cure. When the steam front has arrived at the core, at least a temperature of 100°C has been reached there, and the board commences there also to harden, whereafter the pressing can be finished within seconds. This applies to the use of conventional urea-formaldehyde glues (UF) and the like, such as melamine-reinforced (MUF) glues. When using other glues with higher curing temperature, a higher temperature and a higher steam pressure must be developed in the board before hardening can take place.

In order to bring about desired board properties, a press must be capable to apply high face pressures at high temperatures. This is per se

no problem for a discontinuous press which, however, has other disadvantages, such as inferior thickness tolerances etc. At continuous presses the requirement of high face pressures at simultaneously high temperatures has made necessary expensive precision solutions as regards the roller bed between steel belt and underlying heating plate.

The method of introducing heat to the board via thermal conduction also has the effect that the heating takes a relatively long time, which results in long press lengths (large press surfaces). Presses up to a length of 40 m have been delivered. Besides, at known continuous presses it is practically not possible to make the heating plates sufficiently flexible, so that density profiles cannot be formed as freely as at discontinuous pressing.

Another method of board manufacture based on the introduction of steam between the heating plates in a discontinuous press has also been used to a restricted extent. Since at the supply of steam the material is heated in seconds, the heating time is shortened radically. Besides, the compression resistance of the material is reduced considerably when steam has been supplied. This is a positive feature, which implies that the press could be designed with less press power and substantially shorter length (smaller press surface). In order to obtain desired properties of a board manufactured according to this method, however, it was necessary to apply conventional pressing technique with high surface pressures and thermal conduction from conventional heating plates at the beginning of the press cycle, whereby after a long heating time a face layer with high density was obtained. It was first thereafter possible to blow in steam for heating the core portion of the board. This has involved problems, because the steam had to be blown through the newly formed face layer with high density, and because the pressing time has been extended considerably during the period of high pressure and thermal conduction. Due to all this, a steam press operating according to this concept has a substantially lower capacity, alternatively requires a larger press surface and higher press power than would be necessary when uniform density is desired,

At all manufacturing methods mentioned, a soft face layer with lower strength, unacceptable paintability etc. is obtained, which requires this layer to be ground off. The resulting material loss amounts to 5-15%, depending on board type, thickness etc.

The present invention has the object to offer a novel manufacturing process for the continuous pressing of board of material based on lignocellulose, by which method it is possible to utilize the advantages of steam heating, which implies that then the equipment can be designed with a substantially smaller press surface and lower press power, i.e. less expensive, and, besides, without heating plates, which renders the equipment still less expensive, and thereby substantially producing a board with uniform density profile, which can be used in this state or be further refined.

According to the invention, the pressing at a basic embodiment is carried out so that the mat formed is heated with steam and thereafter compressed to near final thickness, whereafter it is pressed to a manageable board with uniform density profile or with slightly increased face density.

According to one embodiment, the mat is compressed to modest density, whereafter steam is supplied. The mat is thereafter compressed further to above final density, whereafter the mat is allowed to expand slightly and harden to such a degree that a manageable board is obtained.

At a preferred embodiment of the process, the mat coming from the forming (which can be not pre-pressed or cold pre-pressed in a separate belt pre-press if it is desired to better clear belt transitions and to be able to more easily indicate possible metal) is first compressed in a press inlet to a roller press provided with wires to a density of 150-700 kg/m^3, whereafter gas or steam of controlled pressure and overheating degree is supplied through the faces via steam chest(s) and/or steam roller(s). The mat is hereafter compressed successively to less than final thickness by means of roll pairs, whereafter it is allowed to expand in additional roll pairs, whereafter the board hardens.

The roller press should also be heated to prevent condensation at the steam supply. The object of the compression to a thickness less than the final one is to compress the mat strongly, so that smaller loads are obtained in subsequent roll pairs. This method is desirable in order to reduce the loads on the machine, but is not necessary for the process.

The compression of the mat is of importance for the density profile of the board pressed. By adjusting the mat density, at which steam is supplied, the face density of the board can be controlled. At increasing mat density, the density of the pressed board changes from a uniform density profile to a density profile with increased face density. Such an increase in the mat density, however, implies an increase in compression work in the inlet zone of the mat.

At an alternative embodiment of the invention, the mat is heated in the way described above, but continued compression in a calibration section does not take place longer than to near final thickness, whereafter the board is exposed to high heat and line loads in a hot calendering section. Hereby a board with increased face density is obtained.

At this embodiment, the mat is compressed in the inlet wedge to modest density, whereafter steam is supplied in a similar way as described above. The mat is hereafter compressed further to near final thickness and is allowed to partially harden in a calibration section, whereby the board becomes sufficiently stable for continued transport to a hot calendering section, where the board is compressed between roll pairs at supplied heat and pressure to high density, whereafter it is allowed to spring back to final thickness in the outlet.

Contrary to all previously known presses for manufacturing board based on lignocellulose, it was found that from a process-technological point of view it is possible to obtain board with good properties even at high densities in spite of the absence of heating plates.

At the application of the method according to the invention, the steam

is supplied continuously. When a small excess of steam above the amount required for heating the mat is supplied, this ensures that all air enclosed in the mat is pressed rearward in the inlet, whereby it is further ensured that all parts of the mat are heated.

The characterizing features of the invention are apparent from the attached claims.

The invention is described in greater detail in the following, with reference to the accompanying drawings illustrating an application of the invention.

Fig. 1 shows a heated belt press with steam supply.
Fig. 2 shows the density in the thickness direction of a board.

Figure 1 is a lateral view of an equipment according to the invention, comprising a belt press 1 and a hot calendering section 13. The belt press 1 is in known manner provided with drive rollers 2, drawing, rollers 3, guide rollers 4 an adjustable inlet portion 5 with inlet rolls 6, at least one steam roller 7, at least one compression roll 8, calibrating rolls 9 in a calibration section 10 and surrounding wire 11, alternatively perforated steel belt with wire. The mat is compressed in the inlet portion 5 to a predetermined density in the range 150-700 kg/m^3, preferably in the range 250-500 kg/m^3,at the passage past the steam roller 7, whereby steam of 1-6 bar is injected into a sector in contact with the wire in an amount sufficient to heat the mat to 100^{o}C and drive out all included air. The compression resistance of the mat is hereby reduced significantly, and continued compression at the compression roll 8 and in the calibration section 10 can be carried out with very small forces.

At an alternative embodiment, a conventional steam chest can be used at the beginning of the calibration section in order to ensure a sufficiently high temperature during the hardening of the board (depending on board type, etc.).

Due to the use of only rolls, excess steam is free to flow off through the wire, and therefore normally no vacuum sucking-off zone is required at the end of the calibration section. At an alternative embodiment, a vacuum box can be installed in order to facilitate the control of residue moisture and de-flashing of excess steam.

As an alternative or complement to the steam roller 7, one or several conventional steam chests can be used.

When it is desired to improve the density and tightness etc. of the face layer and/or to fine calibrate the thickness measure of the board and/or to provide the board with a suitable pattern or face structure, the board can pass through a section with one or several hot calendering rolls 13 with high surface temperature, possibly preceded by a section 12 where suitable steam, gas or liquid can be supplied as pre-preparation. The hot calendering rolls, at an alternative, can be surrounded by an endless steel belt.

A uniform density profile, as mentioned, can be obtained by supplying the steam at low or modest mat density, and without additional treatment by hot calendering rolls. In Fig. 2 a density profile is shown, which can be brought about at thin board (for example 1 mm), substantially by passing the board through said hot calendering rolls. Still higher face density tops can be achieved by a hot calendering section with roll pairs enclosed by hot steel belt, whereby the board in the hot calendering section is compressed to a face density slightly higher than the desired final face density at high temperature (150-300^{o}C) and be passed through a number of roll pairs and thereafter be expanded to final thickness.

The invention is not restricted to the embodiments described, but can be varied within the scope of the invention idea.

Claims

1. A method for the continuous manufacture of board from lignocellulosic material, where the material is disintegrated to particles and/or fibers, dried, glue-coated and formed to a mat and pressed to a finished board, c h a r a c t e r i z e d i n that the formed mat is heated with steam and thereafter compressed to near final thickness, whereafter it is pressed to a manageable board in a calibration section.

2. A method as defined in claim 1, c h a r a c t e r i z e d i n that the density is controlled of the formed mat before it is heated with steam for controlling the face density of the pressed board.

3. A method as defined in claim 1 or 2, c h a r a c t e r i z e d i n that the mat after heating with steam is compressed to below final thickness and thereafter is allowed to expand to final thickness when it enters the calibration section.

4. A method as defined in any one of the claims 1 - 3, c h a r a c t e r i z e d i n that the mat is compressed with rolls, and the steam is added in an amount above that required for the heating, whereby air included in the mat is pressed rearward in the mat.

5. A method as defined in any one of the claims 1 - 4, c h a r a c t e r i z e d i n that the pressing in the calibration section is carried out with press rolls, and residue steam in the mat is allowed to escape between the press rolls.

6. A method as defined in any one of the claims 1 - 5, c h a r a c t e r i z e d i n that additional steam is supplied in the beginning of the calibration section in order to ensure a sufficiently high temperature during the hardening of the board.

7. A method as defined in any one of the claims 1 - 4, c h a r a c t e r i z e d i n that the board after the calibration section is exposed to hot calendering for fine calibration and/or modification of the face density of the board.

8. A method as defined in claim 7, characterized in that the board at the hot calendering is compressed to a face density slightly above the desired final face density.

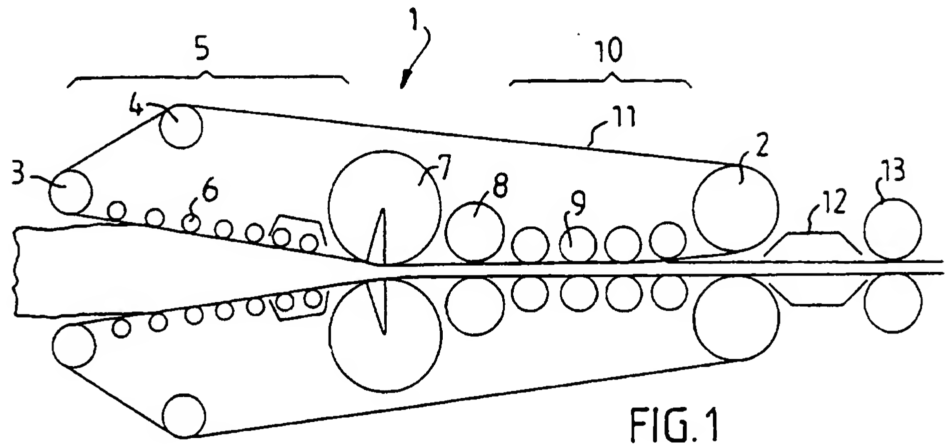


FIG.1

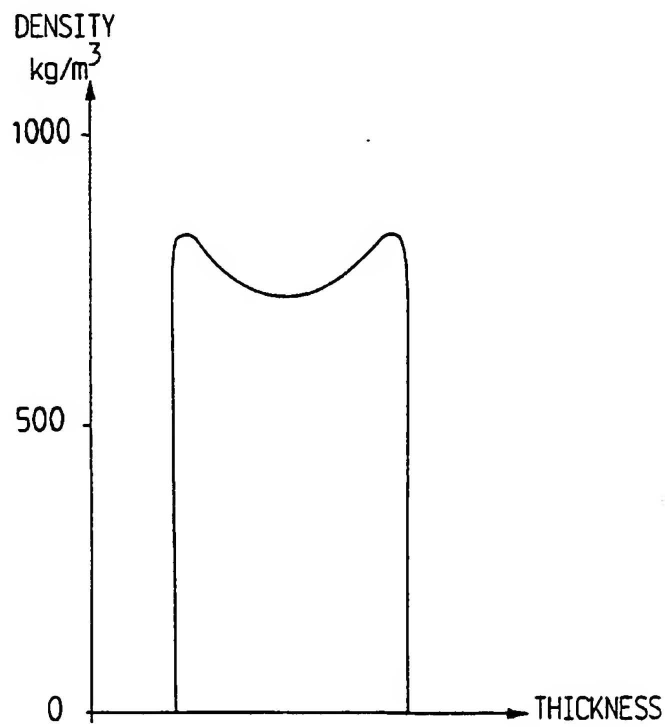


FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00310

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B27N 3/00 // B27N 3/02, B27N 3/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B27N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	WO 9520473 A1 (SUNDS DEFIBRATOR INDUSTRIES AB), 3 August 1995 (03.08.95) --	1
A	DE 2058820 A1 (G. SIEMPELKAMP & CO.), 31 May 1972 (31.05.72) -- --------	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 July 1996	24 -07- 1996
Name and mailing address of the ISA/ Swedish Patent Office B x 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer 01 v Jensén Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

01/07/96

International application No.
PCT/SE 96/00310

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 9520473	03/08/95	NONE	
DE-A1- 2058820	31/05/72	NONE	